

## **CLAIMS**

What is claimed is:

1. A plasma apparatus capable of adaptive impedance matching, comprising:

    a plasma reactor which produces plasma to proceed with chemical vapor deposition process;

    a bi-polar electrostatic chuck which locates inside said plasma reactor to support and secure a wafer and said bi-polar electrostatic chuck has an inner electrode and an outer electrode;

    an alternating current bias power which connects to said inner electrode and said outer electrode, and said alternating current bias power provides the bias for ion-bombardment on said wafer; and

    an impedance matching circuit, said impedance matching circuit connects between said alternating bias power and said bi-polar electrostatic chuck in order to balance a power output of said inner electrode power and a power output of said outer electrode.

2. The plasma apparatus capable of adaptive impedance matching according to claim 1, wherein said plasma reactor has an alternating current plasma generating power.

3. The plasma apparatus capable of adaptive impedance matching according to claim 2, wherein the operating frequency of said alternating current plasma generating power is approximately between 200KHz and 350KHz.

4. The plasma apparatus capable of adaptive impedance matching according to claim 1, wherein the operating frequency of said alternating current bias power is about 13.56MHz.

5. The plasma apparatus capable of adaptive impedance matching according to claim 1, wherein said impedance matching circuit includes a plurality of adjustable impedance-elements, a power-measuring device, a power comparator, and an automatic impedance-regulator; the power outputs of said plurality of adjustable impedance-elements measured by said power-measuring device are compared by said power comparator to get a control signal and said control signal is sent to said automatic impedance-regulator in order to adjust impedance values of said plurality of adjustable impedance-elements.

6. The plasma apparatus capable of adaptive impedance matching according to claim 5, wherein said power-measuring device has a voltage-meter for measuring amplitudes and phases of voltages and a current-meter for measuring amplitudes and phases of currents.

7. The plasma apparatus capable of adaptive impedance matching according to claim 5, wherein said power comparator has a transmitter for sending said control signal.

8. The plasma apparatus capable of adaptive impedance matching according to claim 5, wherein said automatic impedance-regulator has a receiver for receiving said control signal.

9. The plasma apparatus capable of adaptive impedance

matching according to claim 5, wherein said automatic impedance-regulator has a plurality of logic drive motors.

10. An impedance-matching circuit, comprising:

a plurality of adjustable inductors, wherein a first terminal of said plurality of adjustable inductors connects to an external circuit and a second terminal of said plurality of adjustable inductors connects to an alternating current bias power;

a plurality of adjustable capacitors, wherein a first terminal of said plurality of adjustable capacitors connects to a second terminal of said plurality of inductors and a second terminal of said plurality of adjustable capacitors connects to the ground;

a power-measuring device which connects to said second terminal of said plurality of adjustable inductors to measure the power outputs of said second terminal of said plurality of adjustable inductors;

a power comparator which connects to said power-measuring device and produces a control signal for automatic impedance regulation; and

an automatic impedance-regulator which connects with said plurality of adjustable inductors, said plurality of adjustable capacitors, and said power comparator, wherein said automatic impedance-regulator receives said control signal for automatic impedance regulation to regulate the impedance values of said plurality of adjustable inductors and the impedance values of said plurality of adjustable capacitors.

11. The impedance-matching circuit according to claim 10, wherein said power-measuring device has a voltage-meter for measuring

amplitudes and phases of voltages and a current-meter for measuring amplitudes and phases of currents.

12. The impedance-matching circuit according to claim 10, wherein said power comparator has a transmitter for sending said control signal.

13. The impedance-matching circuit according to claim 10, wherein said automatic impedance-regulator has a receiver for receiving said control signal.

14. The impedance-matching circuit according to claim 10, wherein said automatic impedance-regulator has a plurality of logic drive motors.

15. High density plasma chemical vapor deposition equipment with an impedance-matching circuit, comprising:

an inductively-coupled plasma reactor which has an alternating current plasma generating power and said alternating current plasma generating power produces plasma to proceed with a high density plasma chemical vapor deposition process;

a bi-polar electrostatic chuck which locates inside said inductively-coupled plasma reactor to support and secure a wafer and said bi-polar electrostatic chuck has an inner electrode and an outer electrode, wherein said inner electrode locates inside the center portion of said bi-polar electrostatic chuck and said outer electrode locates inside the outer portion of said bi-polar electrostatic chuck outside said inner electrode;

a direct current power which connects to said bi-polar electrostatic chuck and said direct current power provides plus power to said inner electrode of said bi-polar electrostatic chuck and minus power to said outer electrode of said bi-polar electrostatic chuck;

an alternating current bias power which connects to said inner electrode and said outer electrode and said alternating current bias power provides the bias for ion-bombardment on said wafer;

an isolating circuit which connects between said direct current power and said alternating bias power, wherein said isolating circuit has a plurality of capacitors and a plurality of inductors, wherein said plurality of capacitors are used to prevent direct currents from flowing into said alternating current bias power and said plurality of inductors are used to prevent alternating currents from flowing into said direct current power; and

an impedance matching circuit which includes a plurality of adjustable impedance-elements, a power-measuring device, a power comparator, and an automatic impedance-regulator, wherein power outputs of said plurality of adjustable impedance-elements measured by said power-measuring device are compared by said power comparator to get a control signal and said control signal is sent to said automatic impedance-regulator in order to adjust the impedance values of said plurality of adjustable impedance-elements.

16. The high density plasma chemical vapor deposition equipment with an impedance-matching circuit according to claim 15, wherein said power-measuring device has a voltage-meter for measuring amplitudes and phases of voltages and a current-meter for measuring amplitudes and phases of currents.

17. The high density plasma chemical vapor deposition equipment with an impedance-matching circuit according to claim 15, wherein said power comparator has a transmitter for sending said control signal.

18. The high density plasma chemical vapor deposition equipment with an impedance-matching circuit according to claim 15, wherein said automatic impedance-regulator has a receiver for receiving said control signal.

19. The high density plasma chemical vapor deposition equipment with an impedance-matching circuit according to claim 15, wherein said automatic impedance-regulator has a plurality of logic drive motors.

20. A method of impedance-matching for a plasma apparatus, comprising:

securing a wafer to a bi-polar electrostatic chuck by an electrostatic force generated by said bi-polar electrostatic chuck;

generating ion-bombardment on said wafer surface above said bi-polar electrostatic chuck;

measuring an inner electrode power output and an outer electrode power output of said bi-polar electrostatic chuck;

comparing a difference between said inner electrode power output and said outer electrode power output of said bi-polar electrostatic chuck in order to generate a control signal;

balancing the impedance value of said inner electrode and the

impedance value of said outer electrode of said bi-polar electrostatic chuck by said control signal to make said inner electrode power output be consistent with said outer electrode power output; and

proceeding with a high density plasma chemical vapor deposition process.

21. The method of impedance-matching for a plasma apparatus, wherein said high density plasma chemical vapor deposition process comprises depositing dielectric materials into gaps of high aspect ratio in a dielectric layer.